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Lee et al.

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(54) **PROBE INCLUDING AN ALIGNMENT KEY PROTRUDED FROM A SIDE OF AN ALIGNMENT BEAM AND A PROBE CARD INCLUDING THE SAME**

(58) **Field of Classification Search**
CPC G01R 1/06794; G01R 31/2891; G01R 31/2863; G01R 1/07378; G01R 31/2601; G01R 1/07342; G01R 1/07314; H01R 13/2435; H01R 13/2442; H01R 13/2407; H01R 12/52
See application file for complete search history.

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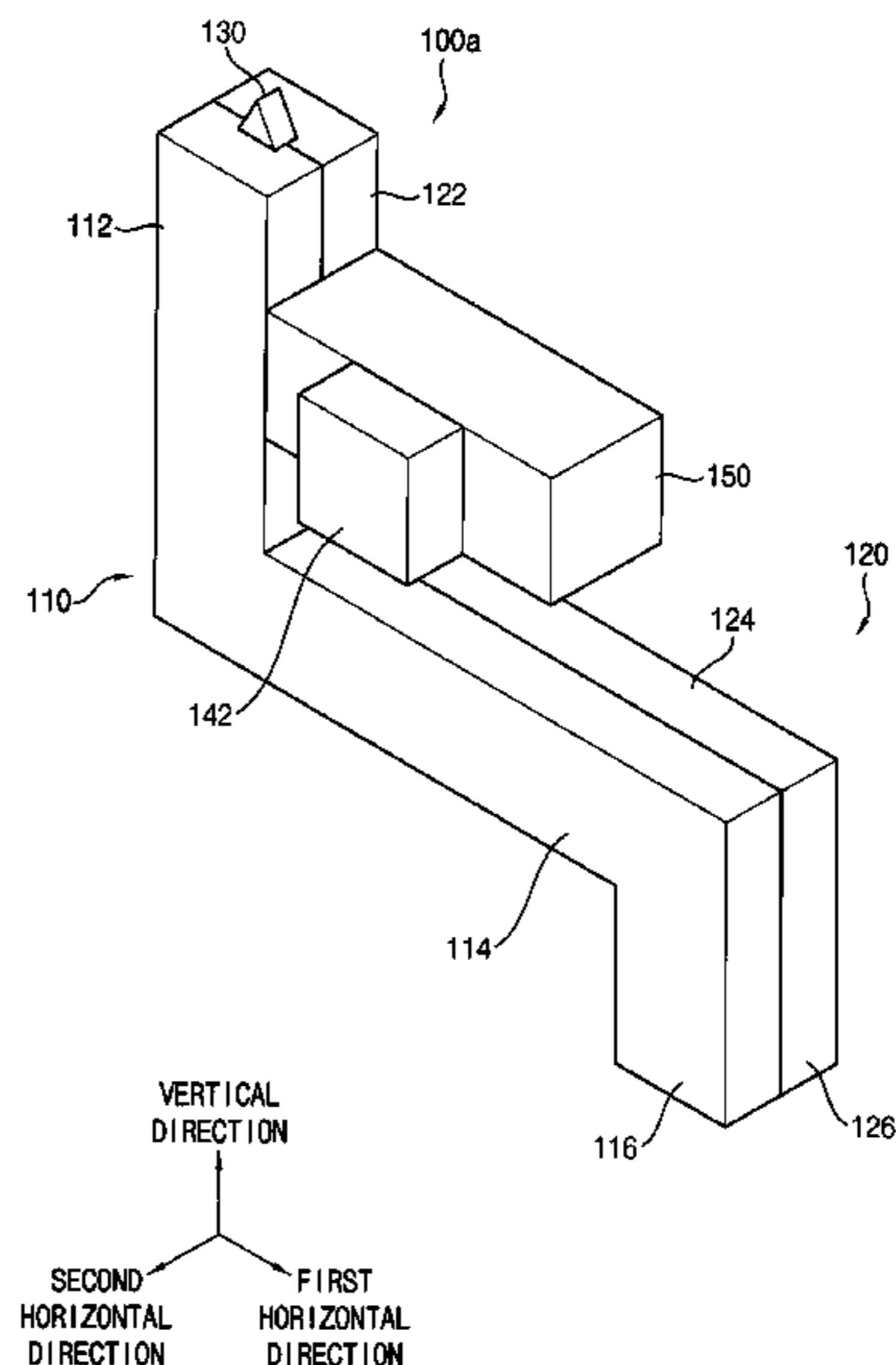
(51) **Int. Cl.**
G01R 1/067 (2006.01)
G01R 31/26 (2020.01)
G01R 1/073 (2006.01)

(52) **U.S. Cl.**
CPC **G01R 1/06794** (2013.01); **G01R 1/07342** (2013.01); **G01R 1/07378** (2013.01); **G01R 31/2601** (2013.01)

(57) **ABSTRACT**

A probe includes a probe body for providing an object with a test signal; a tip arranged on an end of the probe body to make contact with the object; and an alignment key protruded from a side of the probe body.

16 Claims, 9 Drawing Sheets



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FIG. 1

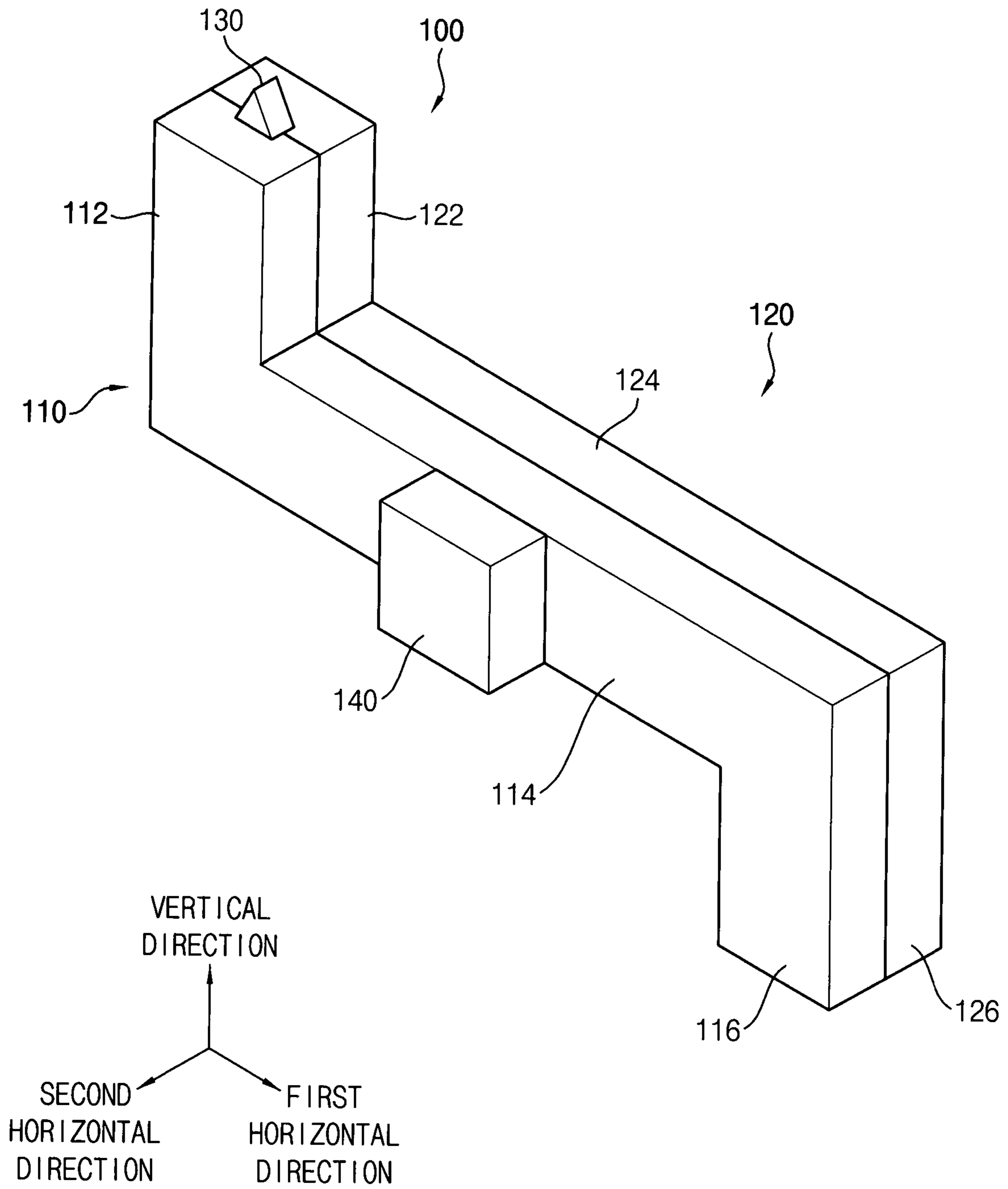


FIG. 2

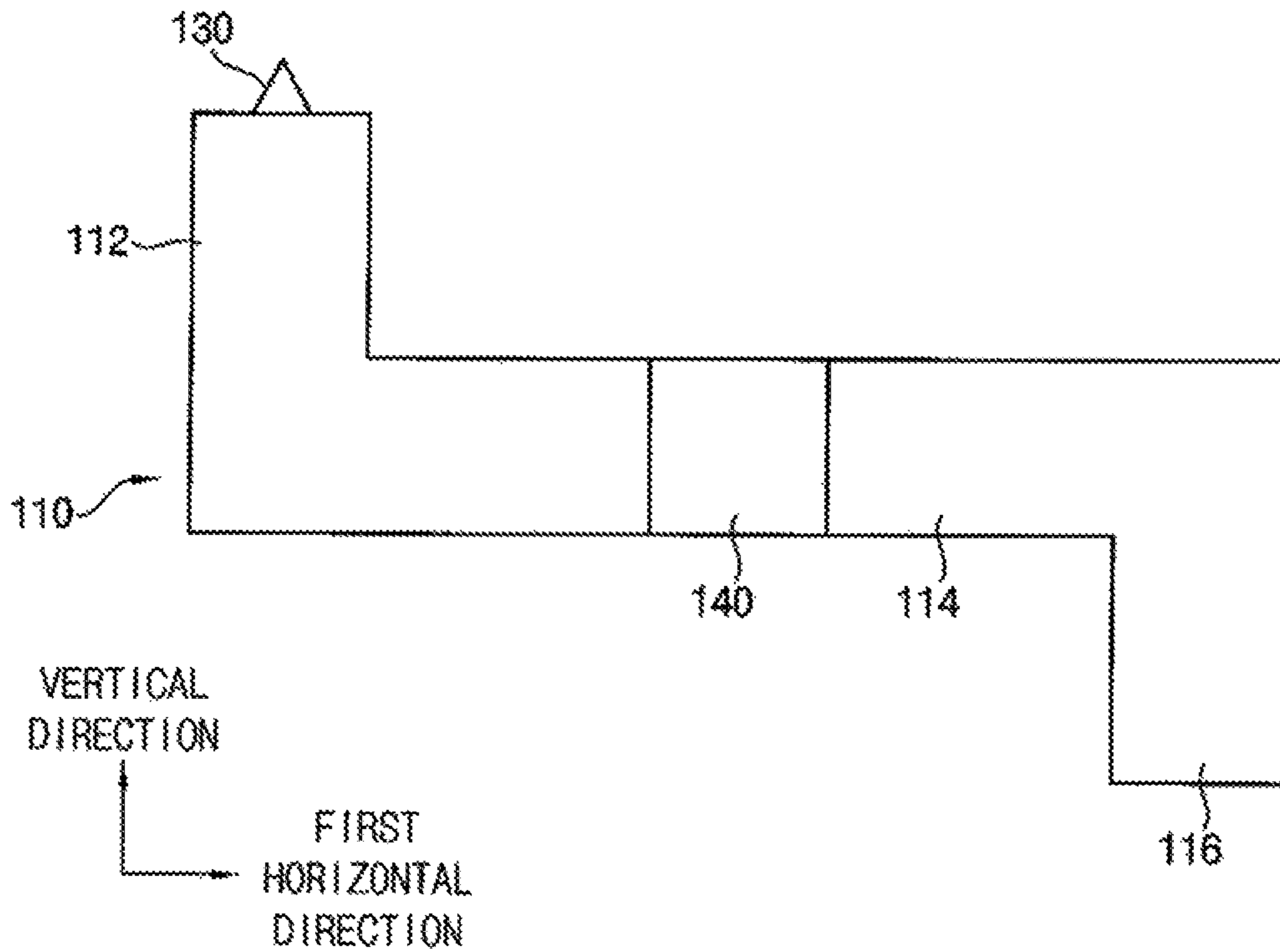


FIG. 3

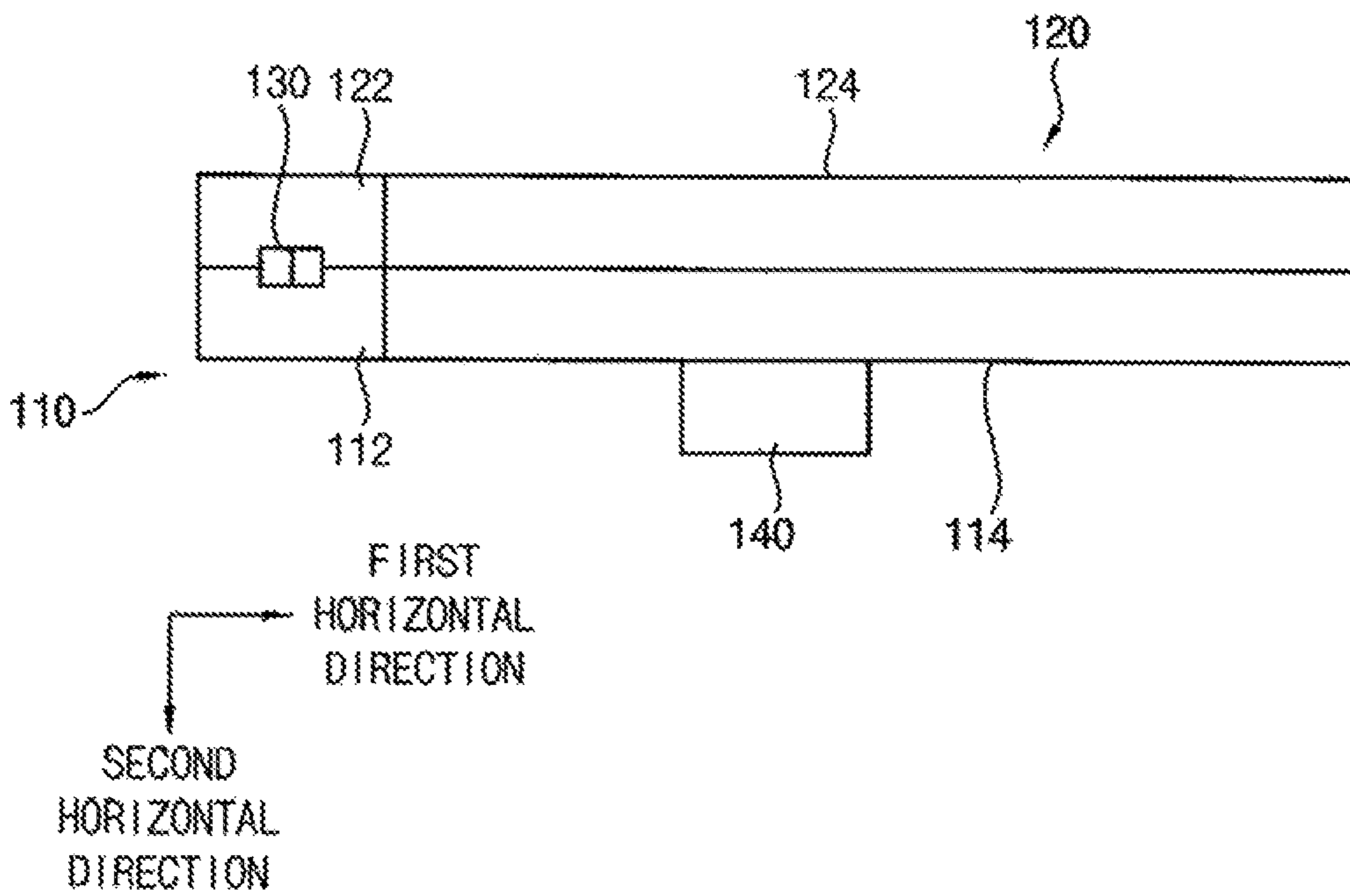


FIG. 4

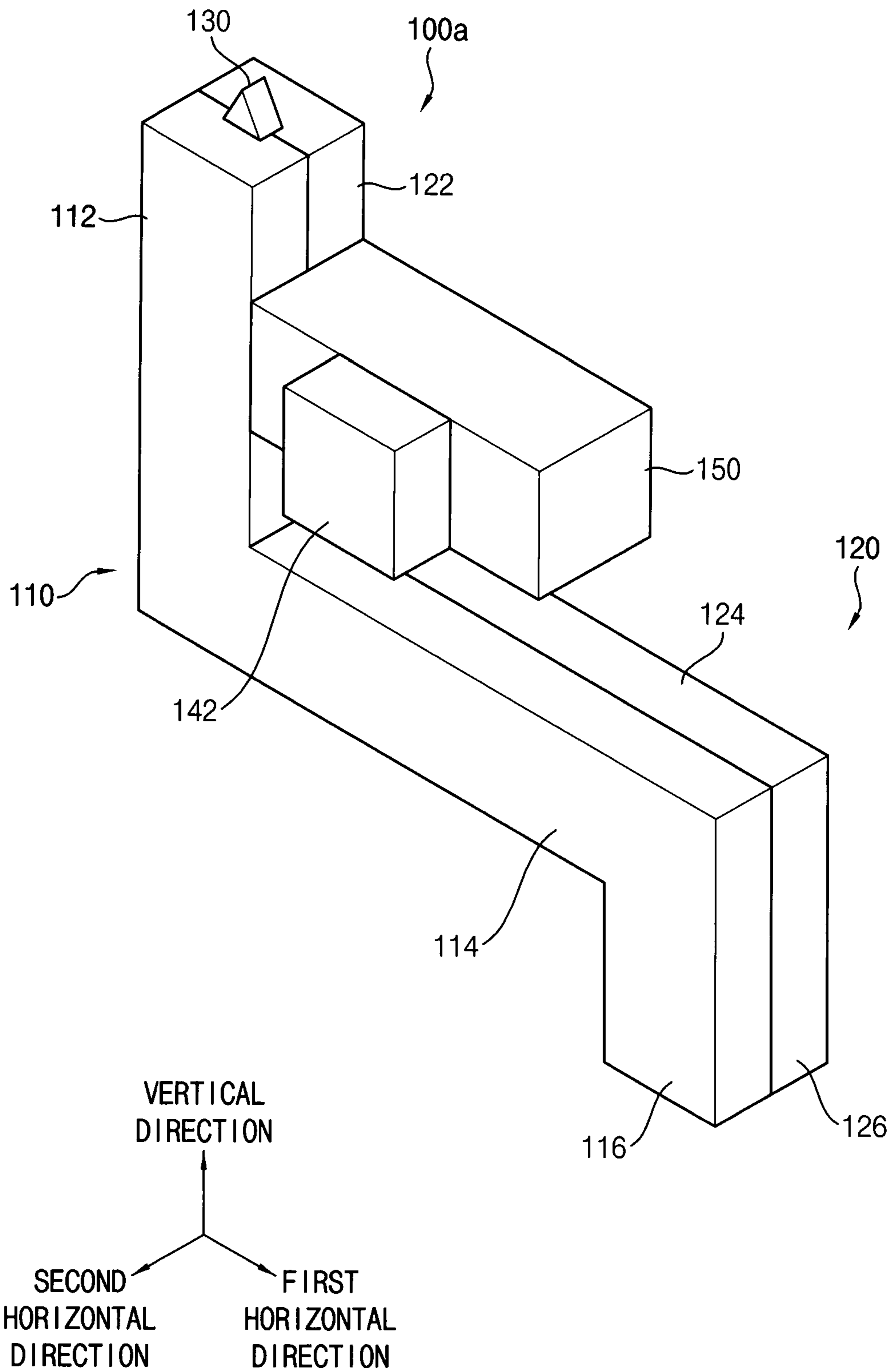


FIG. 5

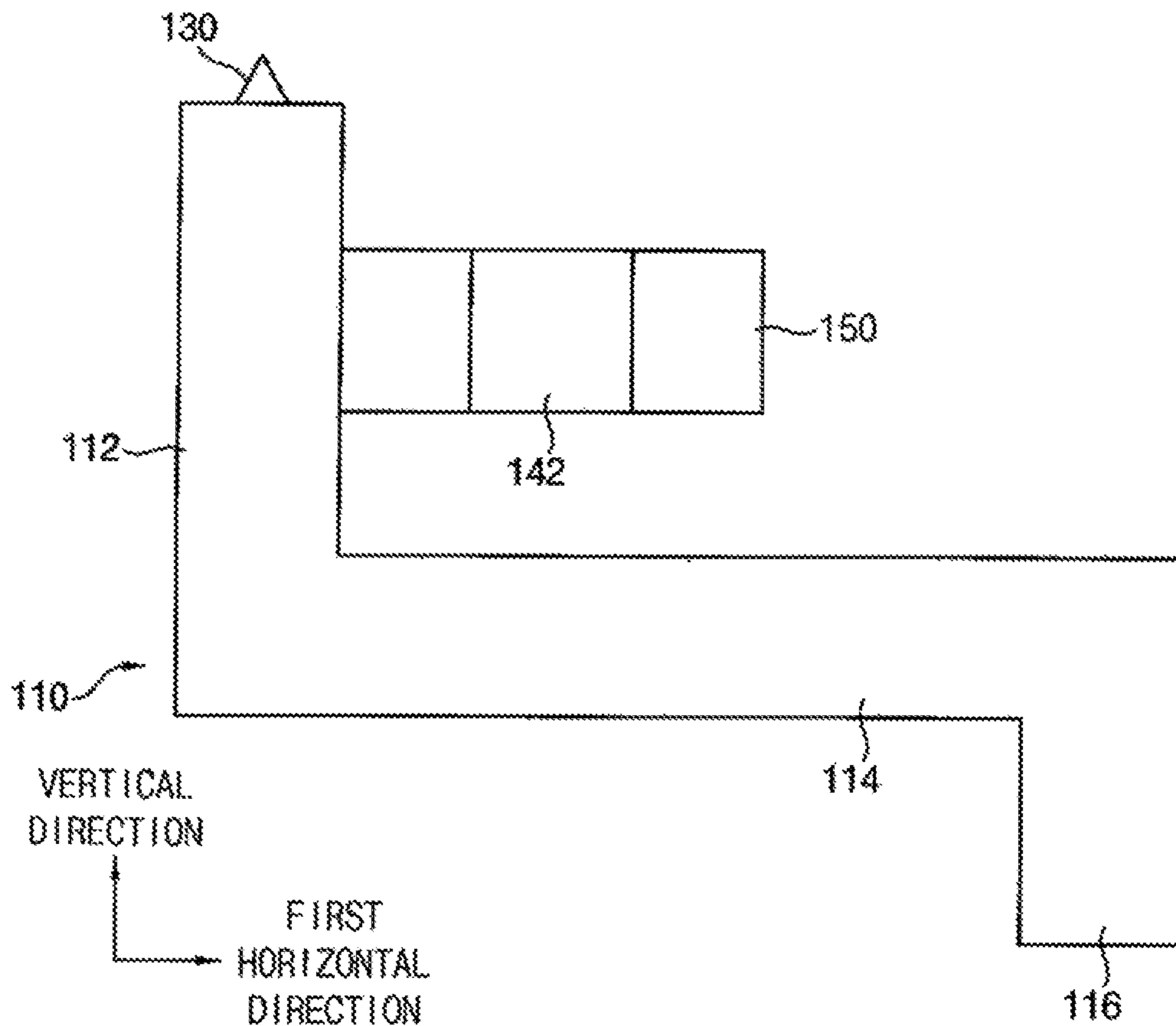


FIG. 6

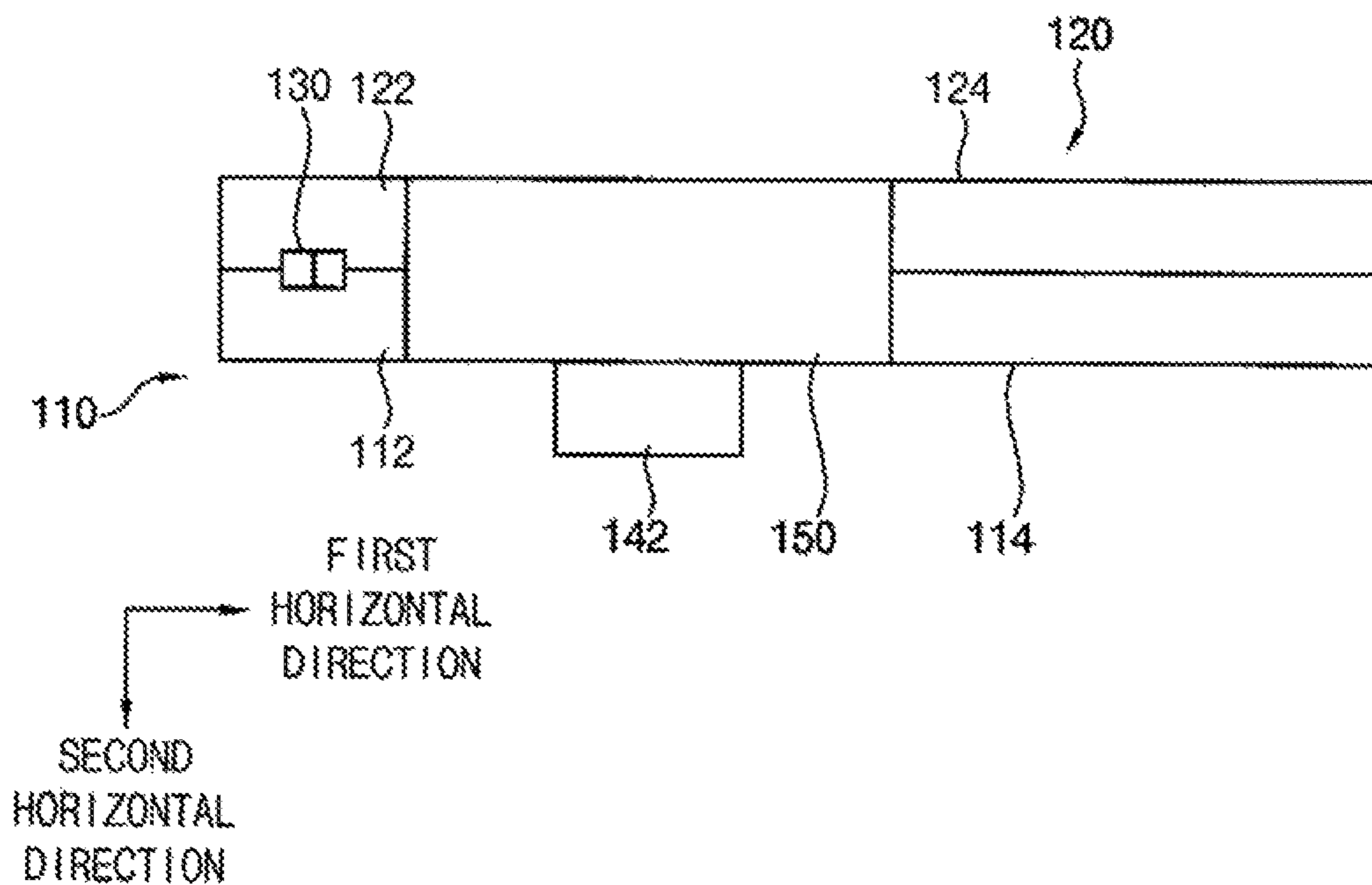


FIG. 7

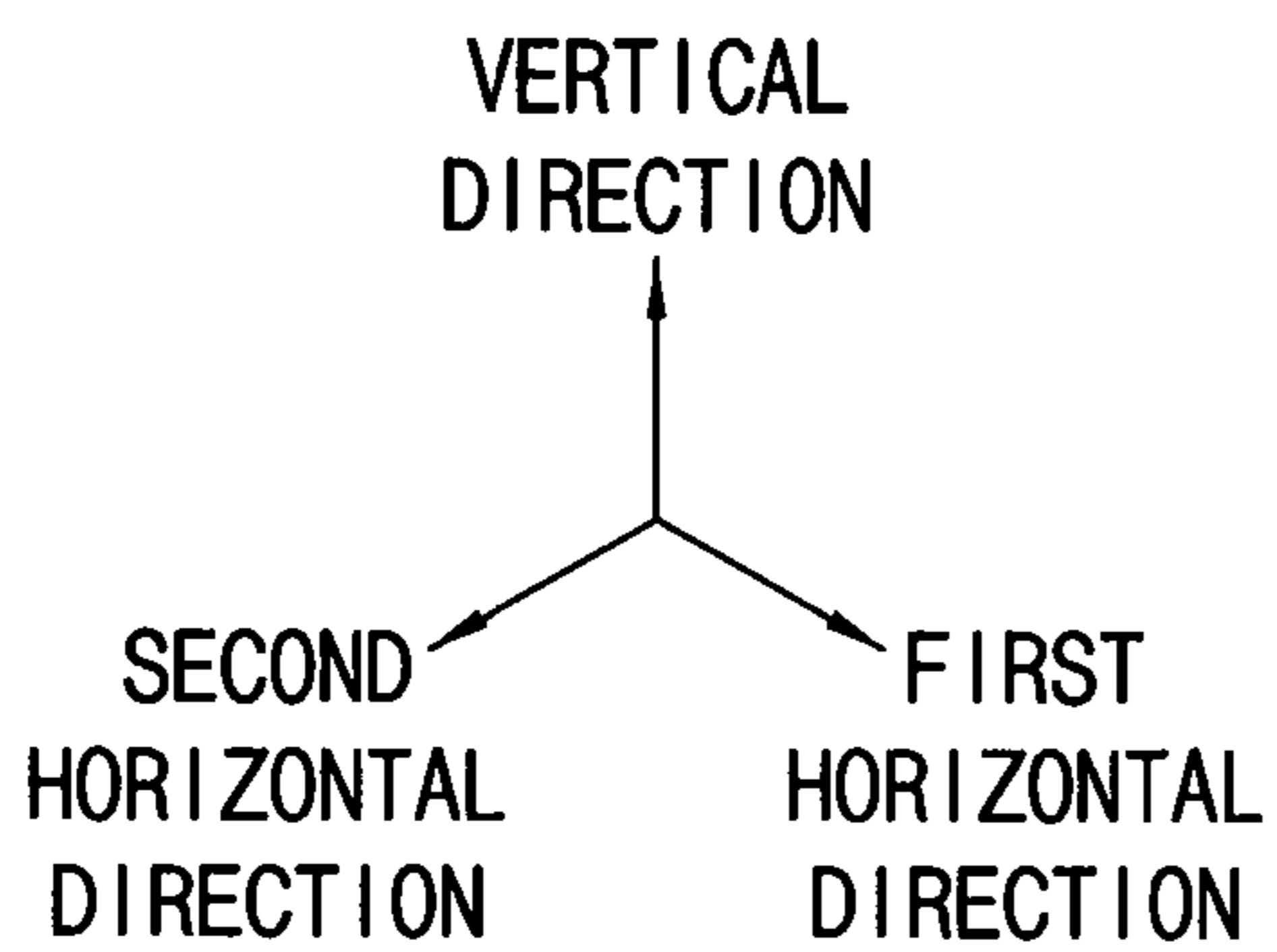
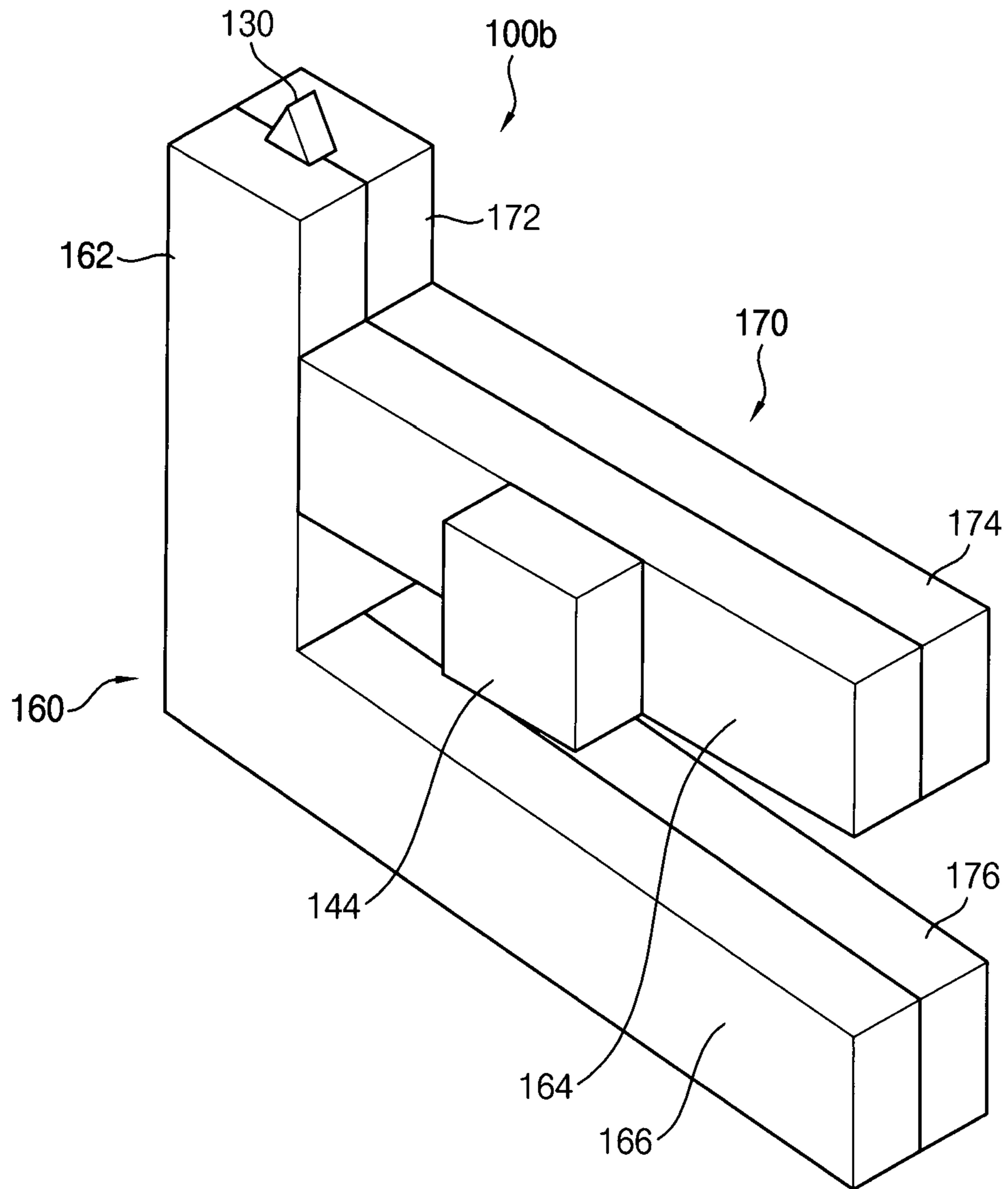


FIG. 8

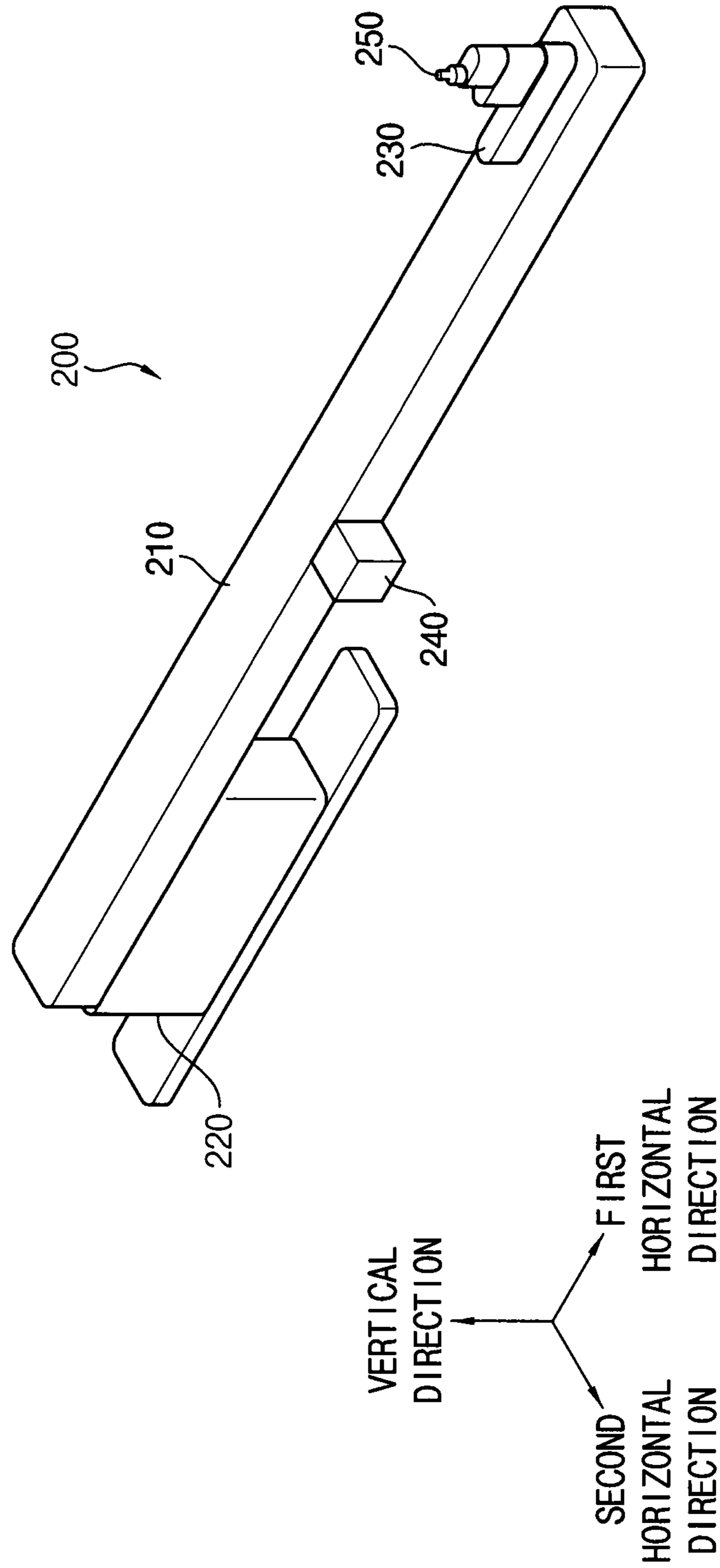


FIG. 9

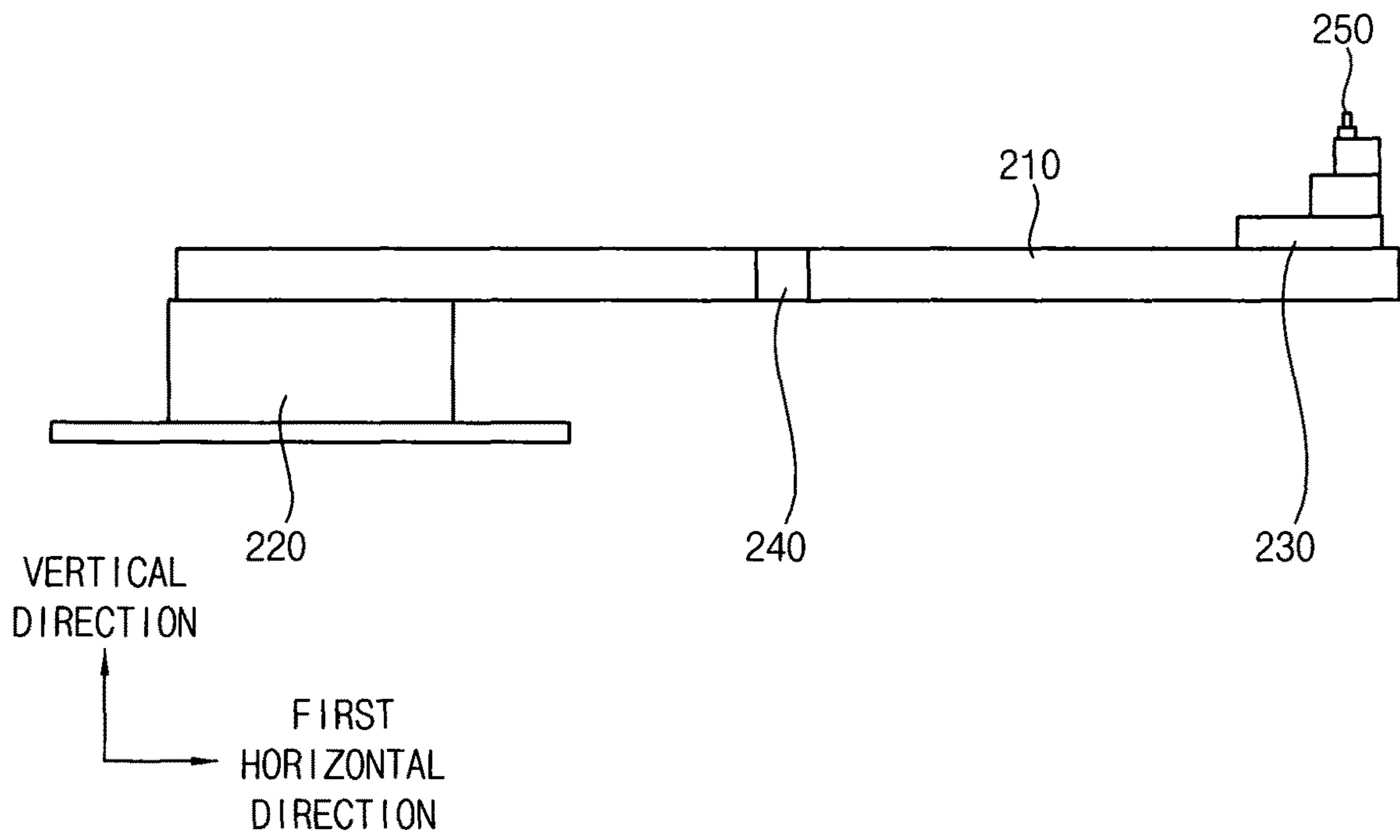


FIG. 10

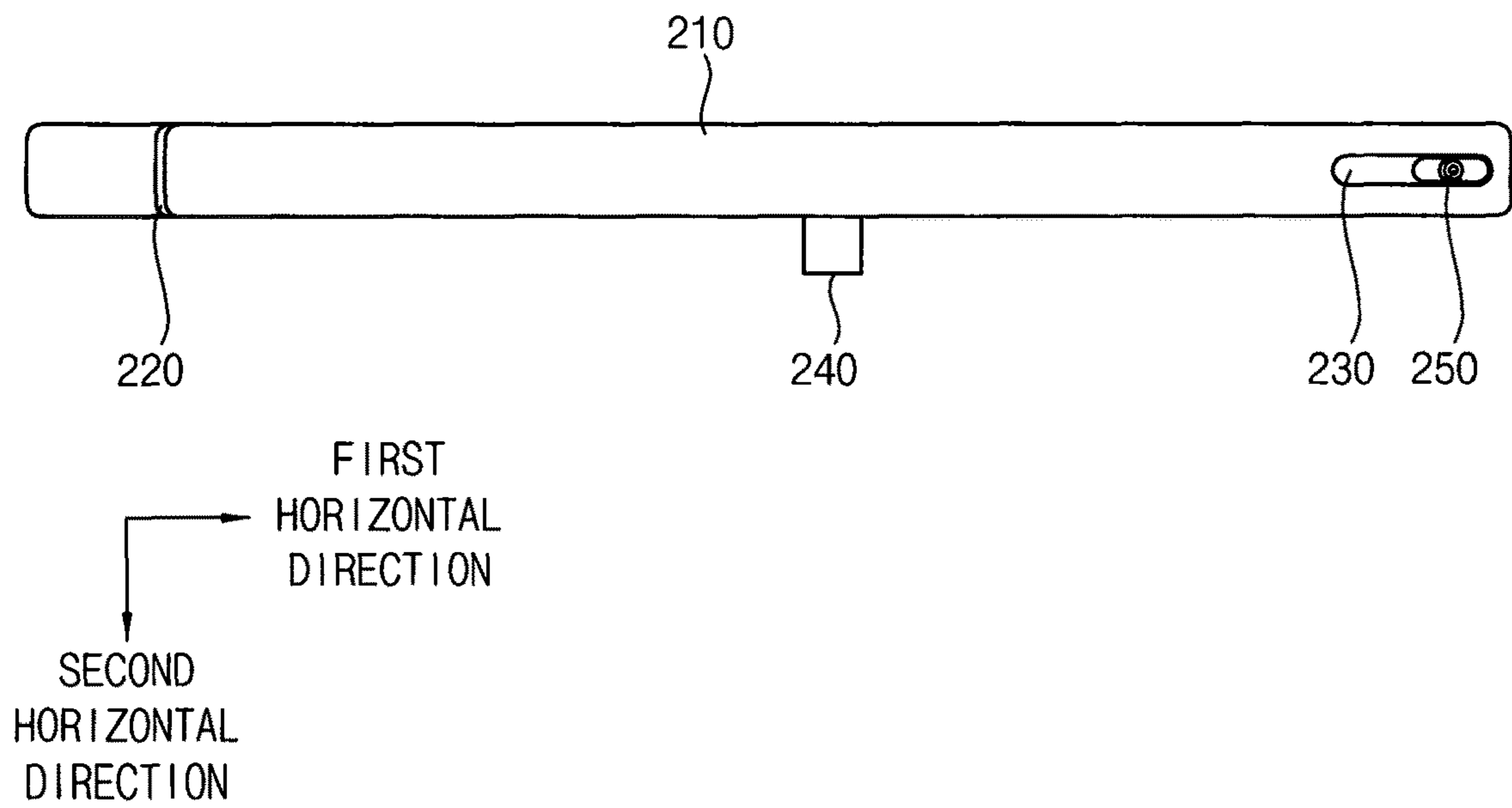


FIG. 11

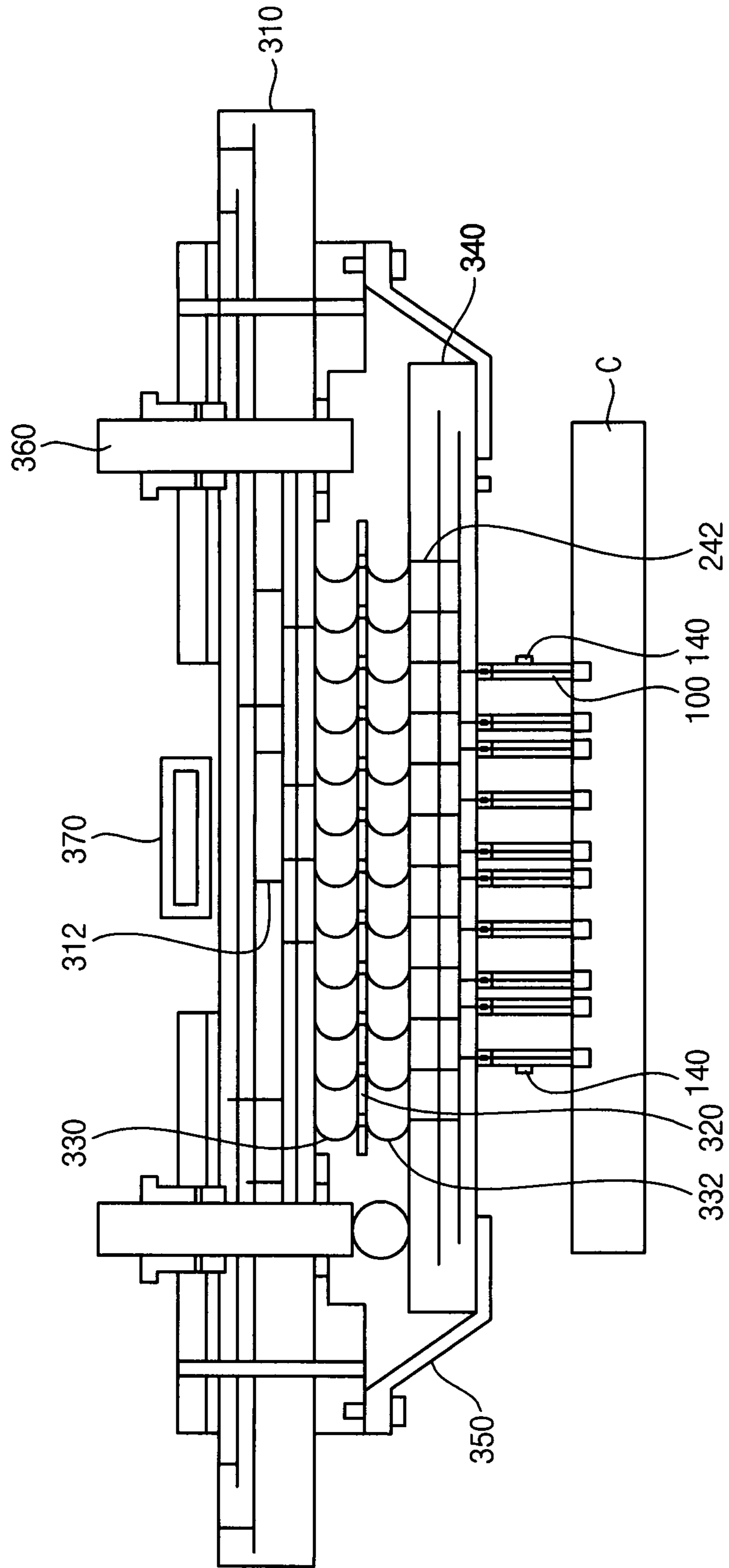
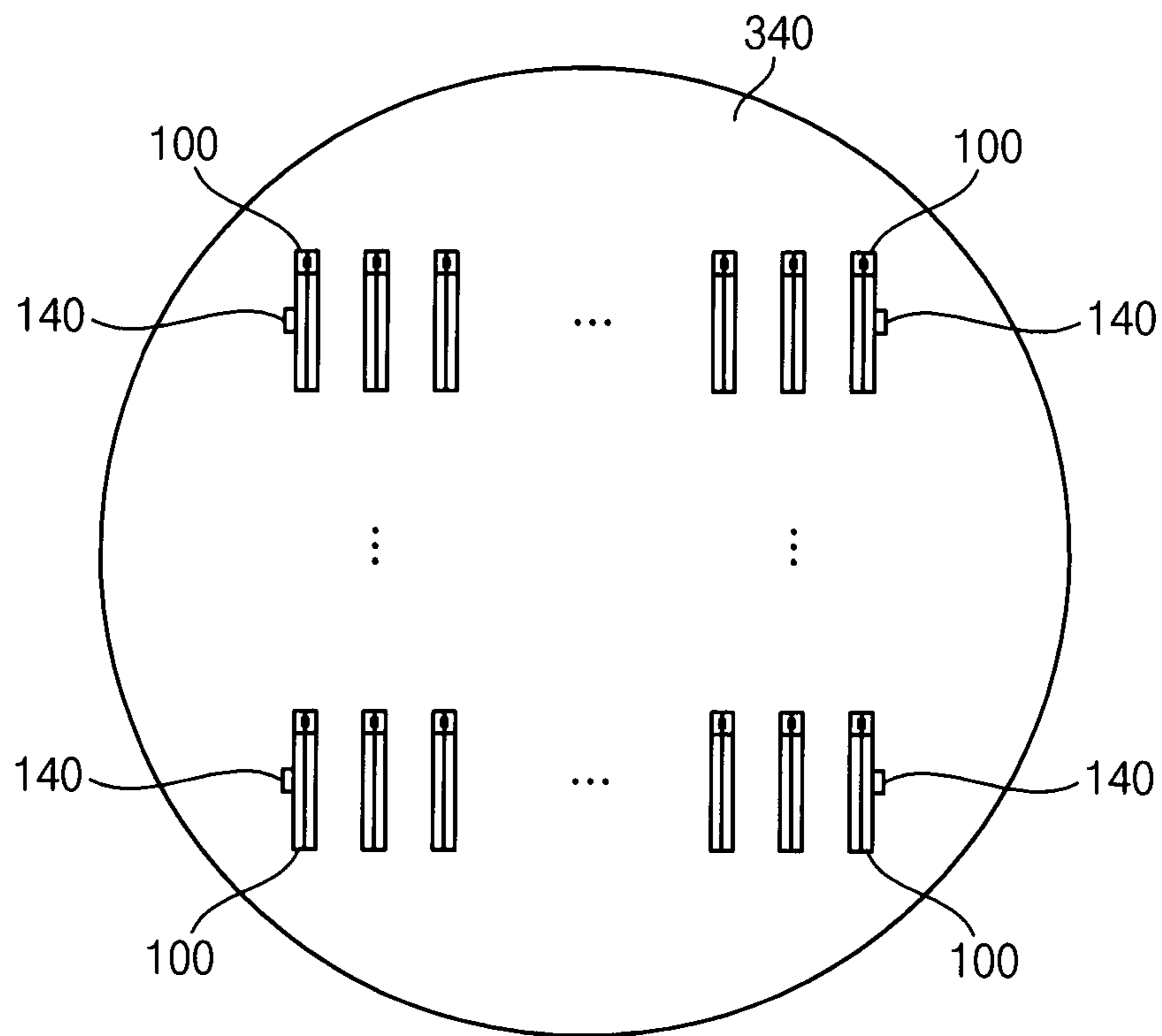


FIG. 12



1**PROBE INCLUDING AN ALIGNMENT KEY
PROTRUDED FROM A SIDE OF AN
ALIGNMENT BEAM AND A PROBE CARD
INCLUDING THE SAME****CROSS-REFERENCE TO RELATED
APPLICATION**

This application claims priority under 35 U.S.C. § 119 to Korean Patent Application No. 10-2018-0108211, filed on Sep. 11, 2018 in the Korean Intellectual Property Office (KIPO), the disclosure of which is incorporated by reference herein in its entirety.

1. Technical Field

The present inventive concept relates to a probe and a probe card including the same.

2. Discussion of the Related Art

In order to test electrical characteristics of a semiconductor chip, a test signal may be applied to the semiconductor chip. The test signal may be generated from a tester. In order to electrically connect the tester with the semiconductor chip, a probe card may be used.

The probe card may include a printed circuit board (PCB) and a plurality of probes. The PCB may be electrically connected with the tester. The probes may be arranged on the PCB, and may make contact with pads of the semiconductor chip. An alignment key for aligning the probes with the semiconductor chip may be arranged on any one of the probes. The alignment key may be arranged on an upper surface of the probe. A camera for photographing the alignment key may mistakenly recognize a similar pattern adjacent to the alignment key as the alignment key. Further, when the probe having the alignment key is used only for aligning the probe, the alignment key may not reflect height changes of the probe in contact with the pads of the semiconductor chip. Thus, the probes may be misaligned with respect to the semiconductor chip. As a result, test reliability of the semiconductor chip may be decreased.

SUMMARY

According to exemplary embodiments of the inventive concept, there may be provided a probe. The probe may include a probe body, a tip and an alignment key. The probe body may provide an object with a test signal. The tip may be arranged on an end of the probe body to make contact with the object. The alignment key may protrude from a side surface of the probe body.

According to exemplary embodiments of the inventive concept, there may be provided a probe card. The probe card may include a printed circuit board (PCB), a plurality of probes and an alignment key. The PCB may include a test pattern through which a test signal for testing a semiconductor chip may flow. Each of the probes may include a probe body, a tip and an alignment key. The probe body may be electrically connected with the test pattern. The tip may be arranged on an end of the probe body to contact with a terminal of the semiconductor chip. The alignment key may protrude from a side surface of the probe body of at least one among the probes.

2**BRIEF DESCRIPTION OF THE DRAWINGS**

The above and other features of the inventive concept will be more clearly understood by describing in detail exemplary embodiments thereof with reference to the accompanying drawings, in which:

FIG. 1 is a perspective view illustrating a probe in accordance with an exemplary embodiment of the inventive concept;

FIG. 2 is a side view illustrating the probe in FIG. 1;

FIG. 3 is a plan view illustrating the probe in FIG. 1;

FIG. 4 is a perspective view illustrating a probe in accordance with an exemplary embodiment of the inventive concept;

FIG. 5 is a side view illustrating the probe in FIG. 4;

FIG. 6 is a plan view illustrating the probe in FIG. 4;

FIG. 7 is a perspective view illustrating a probe in accordance with an exemplary embodiment of the inventive concept;

FIG. 8 is a perspective view illustrating a probe in accordance with an exemplary embodiment of the inventive concept;

FIG. 9 is a side view illustrating the probe in FIG. 8;

FIG. 10 is a plan view illustrating the probe in FIG. 8;

FIG. 11 is a cross-sectional view illustrating a probe card including the probe in FIG. 1; and

FIG. 12 is a plan view illustrating probes on a printed circuit board (PCB) of the probe card in FIG. 11.

**DETAILED DESCRIPTION OF THE
EMBODIMENTS**

Hereinafter, exemplary embodiments of the inventive concept will be explained in detail with reference to the accompanying drawings.

FIG. 1 is a perspective view illustrating a probe in accordance with an exemplary embodiment of the inventive concept, FIG. 2 is a side view illustrating the probe in FIG. 1, and FIG. 3 is a plan view illustrating the probe in FIG. 1.

Referring to FIGS. 1 to 3, a probe 100 may be arranged at a printed circuit board (PCB) of a probe card. The probe 100 may have a two dimensional structure. The probe 100 may include a first probe body 110, a second probe body 120, a tip 130 and an alignment key 140.

The first probe body 110 may include a first upper vertical beam 112, a first horizontal beam 114 and a first lower vertical beam 116. The first upper vertical beam 112 may extend in a vertical direction. The first horizontal beam 114 may extend from a lower end of the first upper vertical beam 112 in a first horizontal direction. The first lower vertical beam 116 may extend from an end of the first horizontal beam 114 in the vertical direction. For example, the first upper vertical beam 112 and the first lower vertical beam 116 may be disposed at opposite ends of the length of the first horizontal beam 114, and may extend in parallel but opposite directions from one another along a vertical direction. The first upper vertical beam 112, the first horizontal beam 114 and the first lower vertical beam 116 may collectively form a rectangular parallelepiped shape having substantially the same width throughout. Further, the first upper vertical beam 112, the first horizontal beam 114 and the first lower vertical beam 116 may be integrally formed with each other, but the inventive concept is not limited thereto.

The second probe body 120 may contact an inner surface of the first probe body 110. The second probe body 120 may have a shape substantially the same as that of the first probe body 110. Thus, the second probe body 120 may include a

second upper vertical beam **122**, a second horizontal beam **124** and a second lower vertical beam **126**. The second upper vertical beam **122** may extend in the vertical direction. The second horizontal beam **124** may extend from a lower end of the second upper vertical beam **122** in the first horizontal direction. The second lower vertical beam **126** may extend from an end of the second horizontal beam **124** in the vertical direction. The second upper vertical beam **122**, the second horizontal beam **124** and the second lower vertical beam **126** may have a rectangular parallelepiped shape having substantially the same width throughout. Further, the second upper vertical beam **122**, the second horizontal beam **124** and the second lower vertical beam **126** may be integrally formed with each other.

An inner surface of the first upper vertical beam **112** may contact an inner surface of the second upper vertical beam **122**. In other words, the first upper vertical beam **112** and the second upper vertical beam **122** may overlap one another. An inner surface of the first horizontal beam **114** may contact an inner surface of the second horizontal beam **124**. In other words, the first horizontal beam **114** may overlap the second horizontal beam **124**. An inner surface of the first lower vertical beam **116** may make contact with an inner surface of the second vertical beam **126**. In other words, the first lower vertical beam **114** may overlap the second vertical beam **126**. The first lower vertical beam **116** and the second lower vertical beam **126** may be connected to the PCB.

The tip **130** may be disposed at an area of overlap between upper surfaces of the first and second probe bodies **110** and **120**. Particularly, the tip **130** may be disposed in a space between the upper surface of the first upper vertical beam **112** in the first probe body **110** and the upper surface of the second upper vertical beam **122** in the second probe body **120**. The tip **130** may contact a pad of a semiconductor chip.

The alignment key **140** may be provided in a plurality of areas of the probe **100**. For example, the alignment key **140** may be disposed on at least one of the probes **100**. In exemplary embodiment of the inventive concept, the alignment key **140** may be arranged on a side surface of the first probe body **110**. In other words, the alignment key **140** may protrude from an outer side surface of the first probe body **110** in a second horizontal direction substantially perpendicular to the first horizontal direction. Particularly, the alignment key **140** may protrude from an outer side surface of the first horizontal beam **114** of the first probe body **110** in the second horizontal direction. Thus, the alignment key **140** may be positioned at a side of the first probe body **110**, but might not be disposed on the upper surfaces of the first and second probe bodies **110** and **120**. For example, the alignment key **140** may protrude from a side surface of the first horizontal beam **114** or the second horizontal beam **124** from a top view perspective. Therefore, a camera may accurately recognize the alignment key **140**, and not mistake a similar pattern for the alignment key **140**.

Further, in order to accurately recognize the alignment key **140** by the camera, the alignment key **140** may include a fin, annular, and/or angular shape, and may have coloration, when viewed from the camera, that contrasts with the remainder of the probe **100**. In exemplary embodiments of the inventive concept, the alignment key **140** may have a rectangular parallelepiped shape. The thickness of the alignment key **140** may refer to the portion of the alignment key **140** that extends in the first horizontal direction. The alignment key **140** may have a thickness substantially the same as that of the first horizontal beam **114**, but is not limited thereto. According to an exemplary embodiment of the inventive concept, the thickness of the alignment key **140**

may be greater or less than the thickness of the first horizontal beam **114**. Further, the alignment key **140** may have various geometric shapes and thicknesses and is not limited to the above described examples.

In exemplary embodiments of the inventive concept, the probe **100** may be formed by the following processes. Three metal layers may be sequentially formed on a substrate. The metal layers may be patterned to form the first probe body **110**, the second probe body **120** and the tip **130**. The first probe body **110**, the second probe body **120** and the tip **130** may be detached from the substrate. An alignment key **140** may be formed at any one position on the probes **100**.

FIG. **4** is a perspective view illustrating a probe in accordance with an exemplary embodiment of the inventive concept, FIG. **5** is a side view illustrating the probe in FIG. **4**, and FIG. **6** is a plan view illustrating the probe in FIG. **4**.

A probe **100a** of the present embodiment may include elements substantially the same as those of the probe **100** in FIG. **1** except for a position of the alignment key. Thus, the same reference numerals may refer to the same elements and any further illustrations with respect to the same elements may be omitted herein for brevity.

Referring to FIGS. **4** to **6**, the probe **100a** may further include an alignment beam **150**. The alignment beam **150** may extend from the inner surfaces of the first and second upper vertical beams **112** and **122** in the first horizontal direction. For example, parallel surfaces of the first and second upper vertical beams **112** and **122** may face the first and second horizontal beams **114** and **124**. The alignment beam **150** may overlap at least a portion of the first horizontal beam **114** and/or the second horizontal beam **124** and may be elevated with respect to an upper surface of the first and second horizontal beams **114** and **124**. The alignment beam **150** may have a length shorter than that of the horizontal beams **114** and **124** in the horizontal direction.

An alignment key **142** may protrude from an outer side surface of the alignment beam **150** in the second horizontal direction. The alignment key **142** of this example embodiment may have a shape substantially the same as that of the alignment key **140** in FIG. **1**, but is not limited thereto. The alignment key **142** may include various shapes and sizes.

FIG. **7** is a perspective view illustrating a probe in accordance with an exemplary embodiment of the present inventive concept.

A probe **100b** of the present embodiment may include elements substantially the same as those of the probe **100** in FIG. **1** except for shapes of first and second probe bodies. Thus, the same reference numerals may refer to the same elements and any further illustrations with respect to the same elements may be omitted herein for brevity.

Referring to FIG. **7**, a first probe body **160** may include a first vertical beam **162**, a first upper horizontal beam **164** and a first lower horizontal beam **166**. The first vertical beam **162** may extend in the vertical direction. The first upper horizontal beam **164** may extend from a middle portion of the first vertical beam **162** in the first horizontal direction. The first lower horizontal beam **166** may extend from a lower portion of the first vertical beam **162** in the first horizontal direction. In other words, the first lower horizontal beam **166** may be positioned under the first upper horizontal beam **164**. For example, the first upper horizontal beam **164** may be disposed to at least partially overlap the first lower horizontal beam **166**. The first vertical beam **162**, the first upper horizontal beam **164** and the first lower horizontal beam **166** may have a rectangular parallelepiped shape having substantially the same width throughout. A second probe body **170** may have a shape substantially the same as that of the

first probe body 160. Thus, the second probe body 170 may include a second vertical beam 172, a second upper horizontal beam 174 and a second lower horizontal beam 176. The second vertical beam 172 may extend in the vertical direction. The second upper horizontal beam 174 may extend from a middle portion of the second vertical beam 172 in the first horizontal direction. The second lower horizontal beam 176 may extend from a lower portion of the second vertical beam 172 in the first horizontal direction. In other words, the second lower horizontal beam 176 may be positioned under the second upper horizontal beam 174. The second vertical beam 172, the second upper horizontal beam 174 and the second lower horizontal beam 176 may have a rectangular parallelepiped shape having substantially the same width throughout.

An alignment key 144 may protrude from an outer side surface of the first probe body 160 in the second horizontal direction. Particularly, the alignment key 144 may protrude from a side surface of the first upper horizontal beam 164 in the first probe body 160 in the second horizontal direction. The alignment key 144 may have a shape substantially the same as the shape of the alignment key 140 described above.

FIG. 8 is a perspective view illustrating a probe in accordance with an exemplary embodiment of the inventive concept, FIG. 9 is a side view illustrating the probe in FIG. 8, and FIG. 10 is a plan view illustrating the probe in FIG. 8.

Referring to FIGS. 8 to 10, a probe 200 of the present embodiment may have a three dimensional structure. The probe 200 may include a beam 210, a post 220, a base 230, an alignment key 240 and a tip 250.

The beam 210 may have a long rectangular parallelepiped shape that extends in the first horizontal direction. The post 220 may extend from a left side surface of the beam 210 in the vertical direction. The post 220 may be electrically connected with the PCB. Thus, a test signal may be transmitted to the beam 210 through the post 220. The post 220 may be integrally formed with the beam 210.

The base 230 may be formed, for example, on a right upper surface of the beam 210. The base 230 may be integrally formed with the beam 210. The tip 250 may be formed on the base 230. The tip 250 may make contact with the pad of the semiconductor chip. The tip 250 may be integrally formed with the base 230.

The alignment key 240 may protrude from a side surface of the beam 210 in the second horizontal direction. The first and second horizontal directions may be substantially perpendicular to one another. The alignment key 240 may protrude, for example, from a middle portion of a left side surface of the beam 210 in the second horizontal direction. The alignment key 240 may have a shape substantially the same as that of the alignment key 140 described above.

The three dimensional probe 200 may be formed by processes for forming the beam 210, the post 220, the base 230 and the tip 250 in a multi-layered substrate. The alignment key 240 may be formed on any one of the three dimensional probes 200.

According to an exemplary embodiment of the inventive concept, the alignment key 240 may be provided on a probe 200 that contacts a pad of the semiconductor chip. Thus, vertical stresses may be applied to the alignment key 240 as well as the pad of the semiconductor chip so that the alignment key 240 may reflect height changes of the probe 200.

FIG. 11 is a cross-sectional view illustrating a probe card including the probe of FIG. 1, and FIG. 12 is a plan view illustrating probes on a PCB of the probe card in FIG. 11.

Referring to FIGS. 11 and 12, a probe card according to the present embodiment may include a PCB 310, an interposer 320, a first pogo pin 330, a second pogo pin 332, a probing plate 340, a supporting plate 350, a pair of gap-adjusting screws 360, a stiffener 370 and a plurality of probes 100.

The PCB 310 may include a multi-layered substrate. The PCB 310 may include a test pattern 312. The test pattern 312 may be arranged in the PCB 310. The test pattern 312 may electrically connect a tester for generating the test signals.

The interposer 320 may be disposed under the PCB 310. The first pogo pin 330 may be disposed between the interposer 320 and the PCB 310 to electrically connect the test pattern 312 with the interposer 320. The second pogo pin 332 may be disposed under the interposer 320. For example, the second pogo pin 332 may be disposed between the interposer 320 and the probing plate 340. The second pogo pin 332 may electrically connect with the interposer 320.

The probing plate 340 may be disposed under the interposer 320. The probing plate 340 may include a probing pattern 242. The probing plate 340 may include an insulating material having a thermal expansion coefficient for compensating for a difference between thermal expansion coefficients of the PCB 310 and a semiconductor chip C. In an exemplary embodiment of the present inventive concept, the probing plate 340 may include a ceramic material. The second pogo pin 332 may be disposed between the probing plate 340 and the interposer 320 to electrically connect the probing pattern 342 with the interposer 320.

The supporting plate 350 may support the probing plate 340. An upper end of the supporting plate 350 may be fixed to the PCB 310, for example, by screws. A lower end of the supporting plate 350 may support a lower surface of the probing plate 340. For example, the supporting plate 350 may have a portion that at least partially overlaps a surface of the probing plate 340 facing the semiconductor chip C.

The gap-adjusting screws 360 may adjust a gap between the PCB 310 and the probing plate 340. The gap-adjusting screws 360 may be threadedly combined with the PCB 310 in the vertical direction. Lower ends of the gap-adjusting screws 360 may be connected to the probing plate 340. Thus, the gap between the PCB 310 and the probing plate 340 may be adjusted in accordance with rotation directions of the gap-adjusting screws 360.

The stiffener 370 may be arranged on a central portion of an upper surface of the PCB 310. The stiffener 370 may provide the probe card with stiffness.

The probes 100 may be arranged on a lower surface of the probing plate 340. The probes 100 may electrically connect with the probing pattern 342 of the probing plate 340. Particularly, the first and second lower vertical beams 116 and 126 of each of the probes 100 may electrically connect to the probing pattern 242 of the probing plate 340. Alternatively, when the probe card may not include the probing plate 340, the probes 100 may be arranged on a lower surface of the PCB 310.

The probes 100 may be arranged on the lower surface of the probing plate 340 in lengthwise and breadthwise directions spaced apart by a uniform gap. Particularly, the probes 100 on the lower surface of the probing plate 340 may collectively form a rectangular shape.

The alignment key 140 may be disposed at four probes 100 among the total probes 100 at corners of the rectangular shape. Further, the alignment key 100 may protrude from the outer side surface of the first probe body 110 of each of the four probes 100 toward an outskirt portion of the probing plate 340. As mentioned above, when the probe card may not

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include the probing plate **340**, the alignment key **100** may protrude from the outer side surface of the first probe body **110** of each of the four probes **100** toward an outskirt portion of the PCB **310**.

The similar pattern may not exist on a straight line from the camera to the alignment key **140** protruded in the second horizontal direction through the outer side surfaces of the probes **100**. Thus, the camera may not mistake the similar pattern for the alignment key **140**.

Vertical stresses applied to the probes **100** during operation may cause a change in probe height. The alignment key **140** may be formed on at least one probe **100** contacting a pad of the semiconductor chip. Thus, the vertical stresses may be applied to the alignment key **140** as well as the pads of the semiconductor chip. Therefore, the alignment key **140** may reflect the height changes of the probes **100**.

Alternatively, the probe card may include the probe **100a** in FIG. **4**, the probe **100b** in FIG. **7** or the probe **200** in FIG. **8**.

According to an exemplary embodiment of the inventive concept, the alignment key may protrude from the side surface of the probe body so that a camera may accurately recognize the alignment key. Thus, the camera may not mistake a similar pattern for the alignment key. The alignment key may be provided to only one among the probes making contact with the semiconductor chip, and the alignment key may accurately reflect height changes of the probe. Therefore, the probe card may be accurately aligned with the semiconductor chip so that test reliability of the semiconductor chip may be improved.

While exemplary embodiments of the present inventive concept have been particularly shown and described, it will be understood by one of ordinary skill in the art that variations in form and detail may be made therein without departing from the spirit and scope of the present inventive concept as defined by the accompanying claims.

What is claimed is:

1. A probe comprising:
 - a probe body for providing an object with a test signal; a tip arranged on an end of the probe body to make contact with the object; and
 - an alignment key protruded from a side of the probe body, wherein the probe body comprises:
 - a vertical beam extended in a vertical direction; and
 - a horizontal beam extended from the vertical beam in a first horizontal direction; and
 - an alignment beam extended from the vertical beam in the first horizontal direction, wherein the alignment key protrudes from the alignment beam such that it does not overlap the horizontal beam in the vertical direction.
2. The probe of claim 1, wherein the alignment key extends in a second horizontal direction substantially perpendicular to the first horizontal direction.
3. The probe of claim 1, wherein the tip extends from said vertical beam.

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4. The probe of claim 1, wherein the alignment key has an angular shape.

5. The probe of claim 1, wherein the alignment key has a rectangular parallelepiped shape.

6. The probe of claim 1, wherein the alignment key is integrally formed with the probe body.

7. The probe of claim 1, wherein the alignment beam is positioned over the horizontal beam.

8. The probe of claim 1, wherein the alignment beam is shorter than the horizontal beam.

9. A probe card comprising:

a printed circuit board (PCB) including a test pattern through which a test signal for testing a semiconductor chip flows;

a plurality of probes, at least one of the probes including a probe body electrically connected with the test pattern, a tip arranged on an end of the probe body to make contact with a pad of the semiconductor chip, and an alignment key protruded from a side of the probe body, wherein the probe body comprises:

a vertical beam extended in a vertical direction; and
a horizontal beam extended from the vertical beam in a first direction; and

an alignment beam extended from the vertical beam in the first direction, wherein the alignment key protrudes from the alignment beam such that it does not overlap the horizontal beam in the vertical direction.

10. The probe card of claim 9, wherein the probes are arranged in the first direction and a second direction on the PCB, and the at least one probe is disposed at an end of a row of the probes.

11. The probe card of claim 10, wherein the alignment key of the at least one probe protrudes toward an outer portion of the PCB.

12. The probe card of claim 11, wherein the alignment key extends in the second direction substantially perpendicular to the first direction.

13. The probe card of claim 9, further comprising:

an interposer interposed between the PCB and the probes; a first pogo pin for electrically connecting the interposer with the test pattern of the PCB; and

a second pogo pin for electrically connecting the interposer with the probes.

14. The probe card of claim 13, further comprising a probing plate disposed under the second pogo pin, the probing plate includes a probing pattern for electrically connecting the second pogo pin with the probes.

15. The probe card of claim 14, further comprising a supporting plate disposed on the PCB to support the probing plate.

16. The probe card of claim 14, further comprising a gap-adjusting screw connected with the probing plate through the PCB to adjust a gap between the PCB and the probing plate.

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